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Gaining Acceptance of Modern Methods

by Irving N. Weschler

This paper is based on a speech, delivered on November 20, 1953, before the Fourth Annual Systems and Procedures Conference, held at Los Angeles, California. Many ideas presented here have been developed through conversations with other members of the Human Relations Research Group, UCLA, especially with Dr. Robert Tannenbaum, and from reading the articles of other social scientists who have made the problem of change the focus of their contributions.

MR. WESCHLER is a research associate in the Institute of Industrial Relations of the University of California, Los Angeles.

As SYSTEMS and procedures experts, you are among a number of experts in the business community whose job it is to recognize organizational difficulties and to find the ways and means leading to their elimination. Well trained in the engineering and management aspects of your job, you operate in a growing technology whose complex problems require solutions of ever greater ingenuity and resourcefulness. With the aid of new tools and techniques, you have learned to face up to the intricacies of your work and to handle the most difficult technical aspects of your job.

The problems which you are facing in gaining acceptance for your services can perhaps best be described in terms of the kinds of resistances which you are meeting—resistances to your ideas, resistances to your methods, resistances perhaps to you as a person. Since each of you in your work is faced with overcoming these barriers, with getting people to accept your ideas and methods, it becomes important for you to analyze what the symptoms and causes of these resistances are and how they can be overcome.

Last year, at this same Conference, Wilford R. Penny defined the problem in terms of human opposition to change. "It may be said," he commented, "that the sparks begin to fly upward when we attempt to lead men in a departure from habit patterns which are comfortable and well established. Habit patterns which on the whole have been productive of satisfactory results and which have the veneration of long use tend to generate an atmosphere of reassurance and stability. Any disturbance of these habit patterns tends to generate apprehensiveness and misgivings."

Another member of your profession, J. M. Juran, wrote about the introduction of new ideas and methods as follows: "The introduction of any new system of operation faces its greatest obstacle in changing the habits of people. . . . The human problems exceed the technical problems in complexity and difficulty. Failure to realize the presence and nature of these human problems creates a high risk of failure for the entire undertaking." There it is, in a nutshell. Failure to recognize the human problems can lead to failure for the entire undertaking!

Our task this afternoon will be to examine these human problems, to recognize the source of their existence, and to speculate on techniques through which they may be overcome.

Barriers to Modern Methods

After taking a training course in human relations, a group of top supervisors agreed on the merits of the so-called "open door policy" in communications. They agreed that employees should have ready access to their boss to make suggestions, to submit grievances, or to see him if they just felt the need to talk to him. In practice, however, an attitude survey in the same company disclosed that the open door had considerably rusty hinges. That is, although the boss's door was supposedly open, it in fact remained closed for all practical purposes.

When the government first introduced some new fertilizers to the farmers of the Tennessee Valley, there was great joy at the prospect of heavily increased yields. The farmers were encouraged to use the new fertilizers. However, after a short period of time, it became clear that in spite of more favorable prospects, the farmers in general preferred to stay with their old methods.

These examples have one common denominator. They describe behavior which is intended to protect an individual from the effects of real or imagined change. This reaction, as Alvin Zander[1] pointed out recently, may be to either real or *imagined* change, since the resister may be reacting to things that are really not change, but which he thinks or fears may be. If a person believes a change has been made, or fears potential change, it makes no difference whether or not it is true in fact. He will act as though there has been a change.

In our efforts to gain acceptance for modern methods, we have to learn to identify the symptoms which might be indicative of resistance to our ideas. Two types should be distinguished: *organizational symptoms,* and *indiviual symptoms.*

Among the most common organizational symptoms are low productivity and low morale. Sloppy work habits increase and absenteeism and turnover are on the upswing. One symptom of resistance should be especially stressed, and that is restriction of output. Those of you who have been concerned with the installation and administration of effective time standards or wage incentive systems are probably quite familiar, perhaps too familiar, with this phenomenon. The classic example of its type is described in the famous Hawthorne experiments at Western Electric where a group of workers failed to respond to various kinds of management incentives in spite of numerous ingenious and concentrated efforts on management's part to provide the necessary motivation. It seems that in this experiment, as well as in so many similar situations, an informal group was able to maintain pressures against changes which management had tried to introduce. It should be noted that the phenomenon of retance to change seem to span the entire gamut of nonfound at all levels in the industrial hierarchy. It is not necessarily limited to union plants; it can be found in nonunion plants, it can be found among the highest of management ranks.

The individual and interpersonal symptoms of resistance to change seem to span the entire gamut of nonadaptive behaviors. The aggressive remark, the sly dig, the obvious disinterest, or the childlike tantrum are typical of the range of behaviors through which resistances can be expressed. It is impossible to make a definitive list of these behaviors, although it might be suggested that understanding how people deal with conflict situations might help us become aware of the kinds of actions on the part of individuals that reflect their resistances to new ideas and methods. Many of us are unwilling to admit failure in this area of understanding, and we are prone to look at ourselves as human relations experts, even though the objective evidence might show us to be otherwise.

Getting Understanding

Getting understanding of people implies becoming aware of their needs and feelings—it implies becoming sensitive to the kinds of cues which they throw off that tell us how they really think and feel—it implies learning to recognize and interpret those aspects of human behavior which go beyond the mere surface manifestations. Making effective use of this understanding involves developing skills in our relations with people, so that we can treat them as individuals rather than as members of groups, as people whose needs and feelings may differ from day to day, or from minute to minute.[2]

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[1] Zander, Alvin. "Resistance to Change: Its Analysis and Prevention," *Advanced Management*. January, 1950.

[2] A training program which is designed to help managers develop both understanding and skills in dealing with people is described in "Training Managers for Leadership," Robert Tannenbaum, Verne Kallejian, and Irving R. Weschler, *Personnel*, January, 1954.

Although all behavior which opposes change is not necessarily resistance, a great deal of it is. As we have already stated, resistance to change seems to protect the indivdual from the effects of real or imagined change. In trying to gain satisfaction for our many personal needs, many of us are motivated to maintain the status quo; that is, we protect ourselves from those experiences with which we are not familiar or whose effects we can not gauge.

In protecting ourselves against these effects of change, be they real or imagined, we are not always acting in the best interests of the organization or in the best interests of those who are trying to gain acceptance for modern methods. It may well be that there exists considerable discrepancy between the so-called personal goals of an individual, that is, the goals toward whose satisfaction he is constantly striving, and the organizational goals or the goals the organization feels ought to be met in accomplishing its particular objectives.

Hard to Generalize

It is, of course, difficult to generalize about the variety of personal needs which might account for the resistance toward real or imagined change. Alvin Zander, who has studied this problem thoroughly,[3] has found it useful to analyze it in terms of a few conditions which he feels are conducive to resistance to change. These conditions might be identified as follows:

1. Resistance to change can be expected if the nature of the change is not made clear to the individuals who are going to be affected. For example, the office staff of a large department store recently returned from a weekend to find their office furniture completely reorganized and the desks moved to meet the requirements of what an efficiency expert considered "sound planning of operations." Instead of appreciating what had been done for them, the office staff rebelled and appointed a committee to seek redress for their grievance from higher management.

2. Resistance to change can be expected if different people see a different meaning in the nature of the change. For example, the installation of a new profit-sharing program in one company produced more trouble than was anticipated because some people saw it as a union-busting device, others looked on it as a form of "speed-up", while only a small part of the work force correctly identified the true motives of management, namely, to give the workers a greater share in the product which they help to produce.

3. Resistance to change can be expected if different involved are caught in a jam between strong forces pushing them to make the change and strong forces deterring them from doing so. For example, placing the company welfare drives on a co-ordinated one-time a year basis may be bitterly resisted by those who have special interests in the success of their own favorite charities. In this instance, the comment "let's forget it; it seems to be more trouble than it is worth" makes it less painful for the individual or group to resist efforts at reform rather than to go through with them.

4. Resistance to change can be expected if individuals are not made to see how the change satisfies some of their personal goals and aspirations. For example, moving a worker from one position to another which offers better promotional opportunities may not have the desired effect unless those oportunities are explained to the worker and unless he has a desire to be promoted.

5. Resistance may be expected if change is proposed on personal grounds rather than in terms of impersonal requirements or sanction. Many good ideas are blocked when they are introduced with "I want you to" instead of with "wouldn't it be desirable if we" or something of the sort.

6. Resistance may be expected if the change ignores already established institutions within the organization or work group. For example, interference with the "holy ritual" of the coffee hour might cause more restriction of output and other organizational breakdowns than if the issue had not been raised in the first place.

Techniques for Gaining Acceptance

People who have concerned themselves with the problem of gaining acceptance of new ideas and methods generally suggest three different techniques by which this might be accomplished: (1) the selling approach, (2) the consultation approach, and (3) the participation approach.

The *selling approach* is perhaps the most commonly used and also the easiest to apply. You work out the plans and ideas rather carefully, determine the best approach in terms of "putting them over," and then go out and sell them. Sometimes you go a bit further; after you have gone through your sales pitch, you give the boys a chance to ask questions, and you try to answer these questions as frankly as you can.

From your own experience, you are probably aware that the selling approach works in only a few instances. In spite of your good intentions, and in spite of the merits of your case, you discover that you have a tough time selling people on new ideas and methods unless you can prove to them that these ideas and methods work to their personal advantage. It seems that the most you can hope to accomplish with the selling approach is to make a dent in the intellectual thinking of your "customer," but there is little chance that you will make an impact in terms of getting him to act the way you want him to act.

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[3] See Alvin Zander, *op. cit.*

The *consultative approach* to the acceptance of new ideas and methods involves, as the name implies, consultation with the people who are going to be affected by the change. In practice, it means that you, as the change agent or person introducing the change, have formulated the preliminary plans on how the change is to be accomplished, but that these plans are subject to modification after determination of the feelings and reactions of the people who are going to be affected. Using the consultative approach implies that those of us in decision-making positions do not necessarily have all the answers, but are willing to get help from those who are working on the line. It also implies, however, that final decisions remain vested in us; in other words, that we can use whatever help we get in the manner we think best. The success of this approach depends largely on our gaining acceptance of ourselves, of our integrity, of the quality of our work. Again we must keep in mind the motivation of those who are being consulted; unless they can see the benefit of giving their ideas, their contribution will probably be negligible.

Third Approach

A third approach, the *participation approach,* has received considerable attention during recent years because of the many startling successes which have been achieved through its use. Basically, this approach implies that new ideas and methods can best be introduced if all people who are going to be affected have a part in formulating the change and in implementing the plans for its accomplishment. This method recognizes that if people have the opportunity to work through from the beginning on a new idea or method, they are likely to recognize the proposed change as something worthwhile, as an improvement to which they themselves have contributed. As Robert Tannenbaum has said, "If change is something that is brought about by the group, the group, because of its participation, will be back of the change."

We cannot cite the numerous research evidences which tend to support the superiority of the participation approach. Let me just present one example.[4] It stems from a study which was conducted about four or five years ago in a sewing plant of the Harwood Manufacturing Corp. in Virginia. In this company an experiment was set up to try to measure the relative effectiveness of different methods of introducing a change. Four groups were selected, four groups that were matched in many important respects. The First group was called a control group. This group had the change introduced to it in the way which had been customary in the Harwood Corporation. This was the selling approach, with an opportunity for the individuals involved to ask questions. In the first experimental group there was participation by representation. A few individuals were chosen to participate in designing the changes to be made in the job and in setting the new piece rate. Then these representatives went back to the group, told the other members what had taken place and helped train them in the new method of performing the work. The second and third experimental groups used total participation. Here every member of each of the groups participated in designing the changes to be made in the job, in setting the piece rate, and in learning the new method of work.

Now what were the results? Prior to the change, all four groups were producing around 60 units per hour under an incentive system where a unit was defined as one minute of standard work. After the change, production in the control group fell to somewhat below 50 units, climbed thereafter to 50, and maintained the level of 50 units per hour for the balance of the experiment which was approximately 30 days. Interviews conducted with members of the control group during the experiment clearly indicated that restriction of output was taking place and that 50 was now looked upon by the group as the new standard which the group was going to maintain. Marked dissatisfaction with management was expressed, and 17 per cent of the members quit during the experiment. Production in the first experimental group, which participated through representation, fell to about the level of 40 units, but it quickly rose until by the fourteenth day it passed 60 and continued on up to about 65 units. The two other experimental groups, the ones with total participation, fell down in production on the first day but immediately recovered to the level of 60 and thereafter continued to show an increase, reaching a level approximately 14 per cent higher than their production before the change. Not only was there an increase in production for the two groups that had fully participated, but there was definite evidence of less aggression toward management and there was no turnover among the members.

To summarize, we must be prepared to face resistance to change whenever we are trying to promote new ideas or introduce modern methods. The fact that some of these resistances may seem irrational to us does not reduce their impact or diminish their importance. Understanding the nature and source of these feelings of opposition should make it considerably easier for us to accept them and to deal with them. In becoming sensitive to what people are like and to what motivates them, and by learning to act on the basis of these insights, we have actually come a long way toward gaining acceptance of modern methods. **s/p/a**

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[4] Cited by Robert Tannenbaum in "Overcoming Barriers to the Acceptance of New Ideas and Methods," *Proceedings, Fourth Annual Industrial Engineering Institute*, University of California, 1952. For other relevant references, see D. Cartwright, "Achieving Change in People: Some Applications of Group Dynamics Theory," *Human Relations*, 4, 1951; or C. A. Mace, "Resistance to Change," *Occupational Psychology*, January, 1953.

Instructions—

Their Publication and Control

by John T. Coleman

AN EXPERT blueprints the preparation, maintenance and appraisal of written company policies and instructions.

A COMPANY'S permanency of operation, is vested not only in tried and tested employees and continued production, but also in written instructions and orders on how management expects employees to perform a particular function or group of functions. Smooth operating business practices, therefore, are measured by how well established a company's procedures and regulations are. A company's written instructions are standard specifications, whereby its business is conducted.

Established instructions manifest themselves more strongly, perhaps, in that they properly set forth the responsibilities of employees to meet production schedules —the key which assures full utilization of personnel and equipment. In short, the importance of permanent written orders, instructions or policies, are as much a part of business operation and as important as any other function-

Therefore, just as business practice cannot be carried on haphazardly without benefit of adequate planning and effort, this same premise also applies to the coordination and establishment of adequate written policy and instructions.

At this point, the question narrows down to what are the best methods to be used during the planning and formulation of proper descriptive material designed to cover company operations. By leaving out some of the basic rules that should be followed in publication, standardization, and control of instructions, it indirectly contributes to improper organization and inadequate supervision. This type of contribution can be a decided liability if instructons are allowed to become obsolete (reflected in publishing) or rampant as to volume (control).

Let us consider first what is involved in publishing instructions. A second look at the word "publishing" includes a lot more than merely an implication that it is a

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MR. COLEMAN, manager of manuals and forms control, Trans World Airlines, Inc., Kansas City, discussed this subject at a meeting of the Heart of America Chapter, SPA, in January of this year.

one-process operation. Publishing consists of planning, fact finding, analysis of an existing procedure or installation, comparisons and consideration of the most economcal process to be used to make distribution.

Publishing also consists of the use of concise wording, the procurement of forms, if required, indexing, arrangement and composition, coordination and cooperation with other departments and a working knowledge of such departments, the meeting of target dates, evaluation of what the end product will be—whether for training purposes or whether temporary, compiling, drafting and redrafting, and some knowledge of design and proportion. Publishing, therefore, means the proper formulation of basic details which involve all these things into final instructions adapted to and for a particular function of your company and mine.

No Doubt of Requirements

The mention of these various phases of what is involved in publishing, however, is not intended to imply that we intentionally complicate the processes by which we achieve final instructional form. By listing them, it is intended that those of us who are directly concerned with the problem of properly publishing and controlling instructions, be fully aware and leave no doubt of what is required if we are to fully discharge *our* responsibilities to management.

Actually, this long list of publishing techniques cannot long be conducted in a complicated and costly manner. If the formulation and issuance of instructions become complicated and a cumbersome process, it is an indication that we ourselves, are to blame to some extent, for such complications.

Publishing instructions, therefore, resolves itself into some of the following basic requirements, not necessarily important in the order given.

1. A working knowledge, among conscientious personnel, of company processes and departmental functions, so that development of instructions may be properly coordinated.
2. Fixing of definite lines of responsibility for development of instructions as to type, depending on the size of the issuing unit or the scope of the instructions.
3. Development of specialization in the issuing unit in order that projects may be completed without waste of time and effort and repetitive evaluation on what approaches or processes should be used.
4. Standardization of composition and arrangement —which includes control of revision activity, dating of pages, forms analysis and specifications, indexing and classification of material.
5. Use of simple words written in logical sequence, preferably and generally following a methodical step by step pattern throughout the presentation and accurately and descriptively presented.
6. Use of illustrations with the last amount of text possible.
7. Development of the most economical reproduction processes to be used in distribution without loss of quality control. Management is as much interested in the unit costs of publishing instructions as in other functions of the company.
8. Continuous analysis of instruction and procedural applications to prevent obsoleteness, unnecessary detail and duplication.

The control of instructions can be compared somewhat to a publishing house or newspaper. The success of a book, periodicals, etc. is measured by the number of subscribers involved and how well it sells, which means to what extent they are used. By this analogy we see that the successful application of publishing processes contributes in a large measure to how well technical instructions, policy, and other information pieces, are received and used. Since the receipt of adequate procedures and their application to employee responsibility are of prime importance to job enlargement by contributing to his training and progression, it is certain that, if conscientiously applied and used, they can be one of the greatest factors involved in company organization and growth. The usage of instructions in its true sense is one of the best tools and means that supervision has of determining to what extent his delegated duties are being carried out.

Must Control Distribution

Unfortunately, the control of instructions also applies much more emphatically to the problem of curtailing unnecessary distribution and cost which has grown as a company's personnel list has grown and made necessary because of inadequate training periods, the turn-over associated with the war production period, and enlargement of company facilities and functions. This has resulted in the issuance of reams of paper covering detailed instructions, forms, information pieces, and other printed matter.

Reduction of costs in producing instructions must not only be the concern of the issuing unit or section, but demands the support and attention of all employees who use them, particularly those in a supervisor's capacity. It should be a prime importance to supervision that management policy and instructions, sales tools, and solicitation programs are properly interpreted and indoctrinated to assure a full measure of return on their employee and equipment investment. The concentration and emphasis that supervision places on performing their duties on the basis of established instructions and brochures, pave the way and do more than anything else to force a study of progressive indirect costs analysis involved in their application, control, and effectiveness.

The control of instructions focuses attention then on some basic requirements as follows:

1. Centralization of publishing units to prevent growth of different methods and proceses, whereby information is published and issued.
2. Clearly defined objectives of what management expects to accomplish, and fixed responsibility for its function and scope.
3. Control of distribution lists to avoid duplication.

Others that must be mentioned, but just as important if the full measure of control is to be accomplished, are as follows:

1. Review of instructions as they are actually being applied to a given function.
2. Analysis of unit costs.
3. Direct application of work simplification of forms design, use, and procurement.
4. Constant improvement in material lay-out.
5. Consolidation of instructions and forms.

How we publish and control instructions is of paramount importance. We must find the proper ways of enforcing constant analysis rather than make sporadic attempts to reduce costs and volume. The means of doing this is available to every business establishment which faces this problem—it has the personnel and facilities already installed to accomplish the job.

In conclusion it does not require special help from outside sources to clean our working files of surplus forms, initiate work simplification programs and eliminate costly detail. It can be achieved by our own concentration of effort, our familiarity with existing problems and their characteristics, and sincerely applying the basic requirements as discussed here in arriving at this goal. **s/p/a**

No Miracle Worker

Don't let your Management expect miracles from you. This error is obvious—you cannot come through under such conditions. Systems work is merely the application of common sense using certain tried and proven systems techniques.

Payroll Techniques

A survey of 156 companies in the Chicago area developed these facts about payroll operations: One-half the companies reporting pay employees either semi-monthly or biweekly; 28% pay weekly. Mechanized equipment is used to prepare payroll checks and records by 70% of companies with more than 200 employees; hand postings are used by 70% of those with fewer than 200 employees. Punch cards are used by 43% of companies with more than 200 people. One full time payroll clerk serves an average of 290 employees. Separate bank accounts for payrolls are used by 90% of the companies, and 60% had written instructions available. "Handling the Office Payroll—A Survey." *Management Review*, March 1954.

Many Offices Still Without Regulations on Phoning

Results of a survey of communication practices of 2400 companies employing a total of over 500,000 persons are presented by type of business and size of office. Among the findings relating to telephone usage are these: 23% have pay phones available; 10% require payment for personal calls; average number of employees per telephone is 2.9; 40% do not provide instructions for employees on usage of telephones. "Office Communications"—National Office Management Association, Phila., Pa., *The Controller*, January 1954.

Employee Selection Can Be Sharpened Now!

FOR TRIMMING inefficiency in company operation, there is no better place to direct the ax than the employee category. Personnel costs have been found to range from 40 to 75 per cent of the operating budget of a company. In the average product or sale, labor cost is three times the material cost. Turnover figures show that it costs a minimum of $300.00 to hire, train and then lose a rank-and-file clerical or factory worker—this is basic investment in the employee, and does not include replacement cost, employment compensation cost, slowdown in production, etc. It shows that it pays to make the right predictions in the hiring procedure. Surveys also indicate that about 1 out of every 4 workers is a marginal performer. The company is fortunate if it breaks even, when the worker's productivity is balanced against his wages plus overhead.

Since 1941, companies have **not** been in a favorable position to utilize scientific personnel techniques. While tools have been available for prediction and control of employee behavior, most companies have shied away from their use. They have tended to hire applicants without regard to their psychological potential for the job, and thus to obtain hands but not efficient workers. Much training money has been spent on new-hires who lacked the basic aptitudes even to learn the assignments, much less perform them efficiently. Many workers whose performance was sub-standard were retained on the job, since replacements were hard to find. The duties of the personnel director were often record-keeping in nature, rather than the assumption of his proper role of personnel administration.

Report of Industrial Psychology, Inc., Tucson

What Are the Possibilities for

Reflective Thinking in Machines?

by Elliot Gruenberg

THE GROWING complexities of our civilization—the multiple problems facing mankind today—make this advanced type of computer most desirable. But can it be done?

THE possibility that thinking may occur in machine-like devices has caught the imagination of psychologists, engineers, mathematicians, and the readers of science fiction. (1, 2, 3) Much controversy exists as to whether the activity in modern computing machines can be considered thinking, or at least equivalent to the mental activity carried on by human beings. Often it seems to be taken as axiomatic by those who speculate on this subject that creating machines that could ape human thinking would be desirable. Yet little attention is paid to considering what possible gain might accrue from the use of such machines as opposed, for example, to what might be achieved by designing machines solely to perform repetitive operations in computation.

Much of the disagreement on the subject stems from the use of differing definitions. E. C. Berkeley (4) maintains, "a machine can handle information, calculate, conclude, choose, perform reasonable operations with information. A machine, therefore. can think." This definition appears too broad for M. V. Wilkes (5) since by a reasonable interpretation of this definition one can conclude that an automatic block signal can think. Mr. Wilkes then decides that imitation of human behavior is a better standard of thinking and uses this as his definition. In all fairness, it should be pointed out that later on in his book, Mr. Berkeley states that machines cannot yet do creative thinking.

Perhaps some of the difficulty arises from not adopting a specific definition that will mark out the kind of human thinking of most value. The kind of thinking of greatest value to human beings is reflective thinking. This is the kind of thinking that is used to change doubtful into settled situations.

Let us turn to the philosopher John Dewey (6, 7) for a definition of reflective thinking: "It is that operation in which present facts suggest other facts in such a way as

"Reflective Thinking in Machines" is reprinted with permission from *Computers and Automation,* a monthly magazine containing essentially non-technical articles and reference information dealing with automatic machinery for handling data and its applications in business and industry. The author, Mr. Elliot Gruenberg, is an engineer at the W. L. Maxson Corp., New York. Any inquiries regarding *Computers and Automation* may be directed to Mr. Edmund C. Berkeley, editor and publisher, at 36 W. 11th Street, New York 11, N. Y.

to induce belief in what is suggested on the ground of real relation in the things themselves." (6,7) Wherever and whenever human beings are faced with recognizing and solving problems, this type of intellectual activity will be found. Basically it is such thinking which has extended civilization and made scientific advances, and which is essential to the carrying on of business and government. Exercise of this thought process is what gives man an ever widening control of the world. It is a purpose of this article to determine whether machines can do reflective thinking.

Dewey made a masterful analysis (6) of this kind of thinking with the aim of improving methods of teaching. From his viewpoint, the objective of teaching should be the stimulating of reflective thinking in human beings, particularly children. In his book, "How We Think," an interesting picture of the process of reflective thought can be found. In this light then let us speculate on the following questions:

1. Can each step of the process of reflective thinking be performed by a machine working on principles now understood?
2. If each such step can be performed, can a single machine do reflective thinking?
3. Would it be desirable to construct such a machine? What would be gained?
4. How would such a machine differ from human beings? Would it be able to acquire human experience?

Our method of approaching these questions will be first, to set forth the characteristics of the process of reflective thinking as it is understood to exist in human beings; then, to determine whether such a process could be carried out by man-made machines; and finally, to consider the possible consequences of such an achievement.

The Raw Material of the Thought Process

To begin with, thinking in human beings proceeds from raw ideas or suggestions which occur spontaneously. This implies that human beings do not have full control of their own thinking process. It is true that the mind cannot be stopped by its owner: "The human understanding is unquiet; it cannot stop or rest; and still presses onward, but in vain." (8) The raw ideas or suggestions arise from the experience of the individual and result from an association with an object, causality, or event.

This lack of control of the thought process is a fundamental stumbling block to the training of the human mind to think. If individuals cannot control their own minds, how can one individual train another's mind? The answer is that the conditions that give rise to the raw ideas, the suggestions, can be controlled; the events or objects which most likely will lead to the suggestions can be placed before the individual. His thinking can be directed but his thought process cannot be controlled.

The ability to think is greatly influenced by the range, depth, and speed of the suggestions which occur to the individual when subject to the underlying situations. These also are factors not entirely under control of the individual.

Two Phenomena

The suggestions which arise out of experience of the individual must be in terms meaningful to him. Two phenomena enhance the acquiring of meanings by the individual; they are concepts and language. Concepts are meanings which have become standardized. They can be reused with assurance, and can be related to a system. The function of language is to select, preserve, and apply specific meanings. Words act (1) to delineate or fence off meanings, (2) to identify them, and (3) to carry or communicate them.

The process of forming suggestions into concepts constitutes the learning process of the individual. For at the start of the human being, all things are vague, hazy, and doubtful; the child only gradually achieves mastery over his body and only gradually achieves awareness of the world around him, as he increases his store of concepts.

If the thinking machine we propose to construct—or at least outline—is to resemble the human thinking being, it will have to possess six basic characteristics of the process of reflective thought.

First, there must exist a way of sensing objects and events. This sensing activity is meant in the broadest sense. It includes the ability to sense light, temperature, the size of objects and the occurrence of these phenomena in terms of time.

Second, there must exist a way of storing sensations; this is memory. In other words, the machine must have a way of acquiring experience.

Third, responses within the machine would be evoked automatically upon the reception of sensations. These are the suggestions or raw ideas.

Fourth, the responses and sensations would be formed

UNIVAC, the electronic computer of Remington Rand Inc., has this supervisory control, or "nerve center." It permits the human operator to supervise and communicate with the computer.

in terms of a language, so that the sensations would acquire meaning and could develop into standardized meanings or concepts.

Fifth, the machine would possess the ability to recognize similarities and differences in new situations compared with situations already stored in its experience. In this way the machine could acquire new concepts. This process repeated over and over will enable it to learn.

Sixth, for the machine to be useful, or at least to be recognized as a thinking entity, the machine must possess a way of communicating results of thought to the outside world in some manner intelligible to human beings.

What about emotions? Emotional drives are basic to all human activity. As John Morley puts it in his book, *Rousseau*, "All good things come from the heart, but must go through the head." This is an eloquent way of saying that the best employment of our feelings is to start the thinking process going. Probably Lindbergh did not rationally choose flying; he did so to satisfy a desire for adventure, and because of the thrills associated with the flying experience. But emotions are not part of the thinking activity. We can conceive of machines, having only the above six attributes, being able to do rational thinking without the motivating drive of emotions. They will automatically process appropriate data they take in by way of their sensations and with no other drive but electric power.

Do Computers Possess the Essential Elements for Thinking?

Let us pause briefly to consider how many of these attributes are possessed by modern computing machines.

All such machines possess sensing elements of some kind. In the case of high-speed digital computers however, almost all such sensations are prepared for it by the programmer. In the case of the IBM 701 data processor, for example, the programmer converts the events and data into a sequence of commands which are recorded on punched cards and sometimes on magnetic tape. This particular machine can have suggestions only in terms of pulses originating in this fashion. There are other digital machines which can sense the contour of an object which is to be copied or sense a curve printed on paper and use this information to control a milling machine which will cut this curve. We can say that computing machinery at present can sense objects and events but only in a limited fashion. This means that if they do think they must think as specialists. It appears possible in the future for such devices to sense the human voice in a manner intelligible to the machines. When this occurs, their field of thinking would be broadened.

The second attribute is the means of storing sensations and acquiring experience. A major component of modern digital computing machines is memory. High-speed storage is used to assist in the momentary computing operation which is demanded of the machine from the "suggestions" received from the punched card or other sensing element. Long-term storage is required for sensations which are expected to be useful in many situations in the future. Because of space limitations, not all such sensations can be permitted to be retained at the machine. For this reason the accumulation of experience by the present computing machine is rather limited. To enhance it, magnetic tape libraries are resorted to.

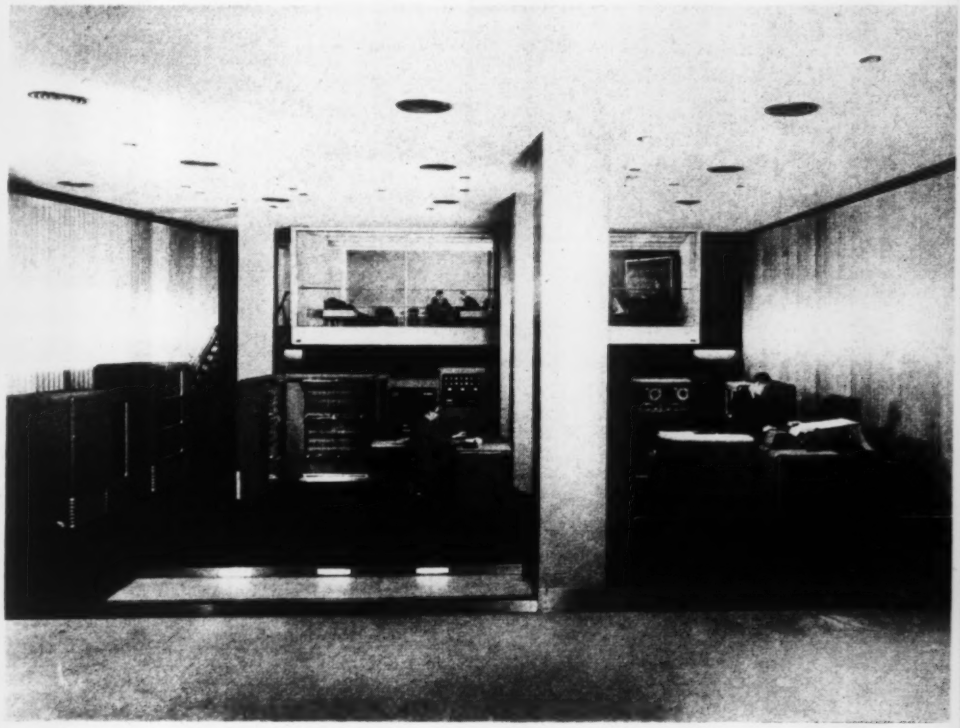
High-speed digital computing machines such as the IBM 701, Univac, and SEAC, do not respond to sensations automatically but require commands or instructions to direct them how they should respond. Special purpose machines however, do respond to specific sensations of a very limited kind and range in an automatic and precise way. The automatic milling machine is an example. Many automatic navigational computers act in the same fashion. Hence, it must be conceded that present-day computers suffer from two serious drawbacks in their usefulness for thinking processes: (1) the kind of response to sensations must be commanded of them, or (2) the range of response to sensation is limited when the kind of response is automatic.

The first limitation cannot be considered inherent in the machines but one imposed upon them by the designers. If the object of the machine is to save repetitive operations for the human calculator, then it is convenient to employ a slave which will follow an established program of instructions. Thus, the current direction of progress in automatic programming techniques has not been to eliminate this master-slave relationship but rather to reduce the number of commands (5, 9). Reflective thinking cannot be done by an entity tied down by such thought control.

An interesting commentary on the second drawback is afforded by the example of the intelligence of birds. Birds, as pointed out by Huxley (10), represent the culmination of a separate line of evolutionary development compared with that which has resulted in man. In the case of birds, emphasis was placed by evolution upon automatic control, or instinct; whereas in man the development of a large memory containing 1010 nerve cells occurred. The frontal part of the brain which contains conscious memory has not developed in birds. Hence they do not rely on experience and learning but do everything instinctively. They fly by instinct (automatic control); they build their nests this way. Huxley cites examples of birds which see their nests only briefly when young and yet when they mature, build them exactly as did their parents. Experiments show that migration in birds is automatically controlled by the amount of daylight they are exposed to. Birds are literally the prototype of present-day guided missiles. Given sensations outside of those which operate their controls, they give no reasonable response.

In regard to the third attribute, responses and sensations are formulated in terms of a language in digital machines. It is true that this language rests upon a system of numbers, but it is conceivable that certain combinations of data may grow to have standardized meanings to the machine. It may be that such machines can form concepts in a much clearer and more dependable fashion than human beings since their coding system would rest on more logical grounds and their means of standardizing meanings would be emotionless and precise. A possible advantage of a number language is that the meaningful words may be formed by summing, multiplying, etc.

The next attributes relate to the ability to learn or form new concepts. Here too we find machines are lacking (5, 9). Some reflection however, leads one to suspect that this lack is not inherent but stems from the aim of their designers. Computers have been designed to perform those routine operations required by complicated or difficult mathematical situations or control problems. The



TYPE 701 Electronic Data Processing Machine, made by IBM, is the first calculator of comparable capacity to be produced in quantity.

objective has been to overcome human drudgery, not to create an independent source of thought. Actually the possibilities of reducing human drudgery by building thinking entities are probably at least as large as those by designing routine machines. Consider that programming of problems for computing machines may take two months whereas the computing machine may do the drudge in two minutes.

What are required are machines which are designed to be able to learn. (5, 11)

Others such as Wilkes (5), Shannon (11), and Oettinger have recognized this need. It should be recognized that our concept of learning is somewhat broader than that employed by them. Learning as used here is the acquisition of meaning. To learn as Oettinger conceived it, was eventually to repeat automatically that which was approved by the instructor. Shannon's maze-solving mouse (11) learned by trial and error, but success was rewarded. Neither the element of approval or success are fundamental to learning, but meaning is.

For a device to learn, then, it should have internal mechanisms and circuits which are able to compare new sensations and sequences of sensations with previous ones and detect similarities. This activity must go on automatically as reception of sensation is received, and the storage of new concepts as recognized must be automatic. The machine must be able to override commands it receives when it has a concept stored in it, upon which it can rely with more confidence than the command itself. How all this might be done will be made clearer when we examine the thought process itself.

Machine Plays Tic-tac-toe

One simple computing machine devised by Bell Telephone Laboratory enginers did have the capacity to learn in a limited fashion. This was a relay device made specifically to play the game of tic-tac-toe. The machine stored sequences of moves it played in a game. If it lost on a certain sequence, the machine would store this fact. The machine would then remember never to use this sequence again. Sinc all this occurred automatically, the machine was learning by itself, and eventually had all the concepts necessary to always win the game.

In regard to the sixth attribute, the need for communication of results is evident. All machines must possess a data readout or a means of indicating solutions. However, there would need to be some indication of the accumulation of standard meanings in the device before it could be recognized as a thinking entity. Such recognition was possible in the tic-tac-toe machine since one was able to tell that it would not play the game in the same way once it had lost in that way. If the world of ideas were to be limited to tic-tac-toe, this machine could then be considered to be thinking. Shannon's maze-solving mouse, which always took the short path once it had found it, is another example of a thinking entity.

The Thought Process

When a person faces a perplexing situation, the opportunity for reflective thinking arises. If he recognizes the need for changing this doubtful, vague or uncomprehended state of affairs into a settled and orderly one that fits into his framework of beliefs, he begins to reflect. Many individuals experience almost a physical discomfort when confronted with such situations and compelled to apply the process of reflective thought. Other people simply do not meet the challenge, perhaps from lack of related experience, or from torpor, or from lack of curiosity.

Once the challenge is consciously or instinctively accepted, the human being's thought process begins. He observes the facts, gathers data. Possible courses of action are suggested, but final judgment is suspended. This last is a telltale sign of reflection. The possibilities or suggested solutions are ideas. Then follows a sequence of mental testing of solutions as to their consequences, and modification of proposed solutions as a result of these tests until all known conditions are met. And so the process continues, the ideas and data are correlated, consequences noted, ideas modified, confirmed, or refuted, until at last a belief is reached which will resolve the perplexities.

For an example of such a process, we may turn to one John Dewey himself describes:

> You are on a ferry boat and you notice a pole protruding from the front end of the upper deck, midway across the beam of the boat. Your curiosity is aroused because it does not appear to have any useful purpose. You begin to reflect; for data you note that the pole contains no hawsers, such as would be used for mounting flags and that one of these poles is mounted at each end of the boat. You consider possible solutions: lightning rod? no, it is made of wood; ornament? no, it is by no means a thing of beauty; nor does it seem to have provisions for use as a hoist. A further fact not considered before is its position directly in front of the pilot house. This suggests the question, "Of what use is the pole to the pilot?" The possibility that the pole might be used to help the pilot steer the boat arises. A few tests follow, such as considering whether the pilot is in proper position to make use of the alignment of the pole, and finally the conclusion is reached that the pole is a steering guide.

I have chosen this simple example to point out how numerous are the opportunities for reflection, and how involved even simple cases may be. If you did not know the answer, do you think you would have easily arrived at it? If the opportunity should arise, test one of your friends. I tested one of mine. He didn't solve it. I daresay very few ferryboat riders have. Try to imagine how a machine could be constructed to do this simple bit of reflection!

The example has revealed that although the thought process was a progression toward a settled condition of belief, nonetheless, there was much confusion of operations. Engineers might recognize a good deal of "feedback" in the process. However, it is valuable to recognize a progression of phases in reflective thinking. John Dewey recognized five phases of this activity. We have paraphrased his exposition of them below:

Phase 1—Recognition of a situation requiring some kind of action. Here the mind is exposed to sensations (data) and suggestions leap forward to possible solution. Key questions which foster reflections at this point are: What facts about this situations are missing? What is unfamiliar in this situation? What data is not related to what is already known about the situation?

Phase 2—Intellectualization of the difficulty into a problem. Perhaps several problems are involved. Useful questions are: Why is the situation unmeaningful? What changes to the situation or our comprehension of it would give it meaning?

Phase 3—Search for solution. Here, one suggestion after another is used as a leading idea or hypothesis to initiate and guide observation and collection of factual data. This is predominantly the creative phase. Thinking is sparked by a wide range of questions. The exact phrasing of the questions depends a great deal on the nature of the problem on hand, but those listed below will give an idea of their nature: How can two or more known facts be combined to effect the desired changes? Can we use more or less of something to improve the situation? What concept can be related to this problem that has not previously been considered? What old method can be applied to this new field?

Many questions of use in this phase can be found in Alex Osborn's book, *Your Creative Power.* (12)

The keynote of this phase is the proposing of some solution. Two attributes of mind are of primary importance at this stage: experience, and a strong flow of suggestions or ideas. Together these constitute what is commonly called imagination.

Phase 4—Evolving the tentative solution into a best solution. The leading ideas or hypotheses are tested, weighted, compared, and judged. Standards of judgment or criteria must be set up as a basis for decision. The possible consequences of the proposed solution must be considered. All these are aspects of the process of analysis which predominates at this point. The end result is one or more hypotheses which are the best apparent solutions to the problem upon which our future action will be based.

Questions which occur at this stage are: What are the consequences of putting this idea into use? What are the best bases for judging the two or more possibilities? What simple tests can we make to prove the point? What computations will resolve the issue?

One of the most emphatic points of Alex Osborn's book (12) is that the exercise of critical judgment, which is desirable in Phase 4, so often blocks useful imaginative thinking, which is essential to Phase 3. Society has encouraged Phase 4 or critical thinking, so that it often occurs before Phase 3 thinking has had sufficient scope. In fact, he organized "Brainstorming" sessions during which only questions characteristic of Phase 3 were permitted. This was done to prevent the occasional "crazy" idea which is really valuable from being lost. This comment is inserted here to emphasize the point that while the phase of judging is of obvious importance, it is useless until the creative phase has supplied ideas in the first place.

Phase 5—Test By Action—Here the best hypothesis is given the test of use. The action may be overt or imaginative, depending upon the subject matter. Conditions are deliberately arranged to see if results theoretically indicated will occur. To the extent that results bear out the hypothesis, confidence in its use is gained, and the doubtful situation has been replaced by a meaningful basis for action. This is another way of defining a concept.

What Gives Motion to the Thought Process?

The thought process thus stands revealed as a set of operations upon mental images or ideas which arise from observation or suggestion. We might well ask: What keeps thinking in motion? Why should it progress from phase to phase? The role of the question becomes plan. The word "question" means literally a seeking. It is by this means that the mind searches for missing or needed ideas, as thinking progresses. The seeking is done in different phases. Hence, the questions change from phase to phase, which is another way of saying that the areas of search change.

It is important to emphasize the observation that the chief difference in the phases of the thought process described above is the difference in the character of the questions which are asked. Becoming conscious of this helps us improve our thinking efficiency. Essentially, these questions select the appropriate images and operations at the proper time. Conscious questioning can influence the thinking process, but much of this questioning is done habitually and hence subconsciously. Training can largely influence the individual's habitual sequence of self-questioning, and indeed much of Dewey's work was directed to this end.

One other process is of importance to stimulate the flow of thought. This is inference. Drawing inferences may be looked on as the process of arriving at that which is absent from that which is at hand. The process involves testing that which is inferred for coherence with what is at hand.[1] Inferences are important in the first phase of situation recognition, and in the fourth phase of critical judgment. In both these situations missing data must often be inferred to permit the thought process to continue.

In concluding our observations on the thought process, it might be noted that the phases exist for only as long as questioning in the given area is nedeed. They are of indefinite duration and importance; and some of the areas of search may be repeated in subsequent stages. Some element in a later phase may cause the process to be repeated through the whole five phases on a narrower scope. Whether this is done is generally considered a function of judgment in human beings. As we have already seen that judgment is the application of a specialized form of questioning, namely, that of comparing conclusions with criteria, it follows that this form of questioning must be present at least in a minor role in all phases of thinking.

Operations Involved in the Thought Process

We are now in a position to evaluate the question whether machines can be conceived to perform the operations of the thought process. Consider first the basic processes of questioning and inferring.

Questioning may be visualized as a methodical searching of specialized memory areas. The difference in the character of the questions appropriate to the several phases of the thought processes is mainly a difference in the area searched, or in the searching routine. We will go into this point further when we examine the operations involved in the separate phases of thought. It is this operation that is mainly responsible for keeping the entire thought process in motion, proceeding from step to step.

Inference involves a processing of the data accumulated up to a point to determine if some element is missing. First, the consequences of the data as it stands must be deduced. For example, using only this data a problem would be solved and an answer obtained. Then the answer is compared with similar previous solutions, and tested for consistency. The machine must then supply from memory tentative missing data and repeat the test until it concludes that the proposed new data is consistent. Thus inference is a combination of the more fundamental seeking operation with that of comparison.

In a similar manner, let us examine the five phases of the thought process and determine if each phase can be broken down into a series of operations which conceivably can be performed by a machine. If such is the case, we have established in a practical sense that reflective thinking can be done by machines. We shall try to describe these operations in such terms that a computer engineer will be able to imagine them being carried out by means reasonably familiar to him. Our belief in the ability of machines to think reflectively should correspond to the extent that these means seem realizable.

In Phase 1, situation recognition, the machine is immersed in a welter of sensations. We can design the machine so that some of these sensations can evoke automatic responses or suggestions. Many means of transforming physical sensations into digital codings are well known. We can imagine a scheme of specialized numbers which will acquire specialized meaning such as words have to human beings. The specialized numbers can of course be represented by electrical pulses.

The stream of coded sensations will be compared automatically with similar concepts already stored in the machine. The data itself will initiate the process. There must be present in the machine means capable of sorting the flow of meanings into classes so that the machine can bring forth from memory similar meanings. This comparative process makes possible the identification of data as unfamiliar. The identification "unfamiliar" gives the signal for the problem-solving process.

Consider as an example, the identification of the function of the pole on the ferryboat. In Phase 1 the question arises as to whether such a pole in such a place is worthy of further attention. Such a question could be simulated by a searching process which brings forth recordings (mental images) of similar situations from memory (or experience) for comparison with the presently sensed image. Comparison circuits can establish the similarity or differences. The judgment can then be formed that the function of the pole is not understood, and the process of reflective thought starts.

Phase 2

In Phase 2, formulation of a problem, the underlying question is "What changes can be made which will reduce the doubtful situation to a meaningful one?" First, the causes of the doubtful situation must be sought: the question "Why?" must be answered. This implies an ability to recognize relationships among things: such as, if A depends on B, and B upon C, then A depends upon C. Our machine must recognize from the observations gathered in Phase 1 the possibility of some relationship. This it does by arranging some of the data and comparing the data with relationships it has standardized and stored in its experience. By this trial and error process the machine arrives at the inherent causal dependence of the new data among itself or it identifies it as dependent on a previously stored concept. When the basic relations are "understood," it becomes possible to identify what is rendering the data unmeaningful in some way. To do this, the machine must review the pattern of relationships in which it has arranged the data with reference to its previous knowledge of relations and identify the inconsistency. When the machine has done this, it has found the problem which must be solved.

In Phase 3, search for solution, the machine needs to search for possible ways to add meaning to the data, i.e., the tentative solutions to the problem. Finding the problem has narrowed the area which must be searched because the kind of change to the data is now known. For example, the tic-tac-toe machine knows that it must place an "X" in one of six remaining squares (a change) in accordance with certain rules. Its problem is thus defined. It can confine its search to its memory of all possible situations, find one like the present one, and so determine the proper move to make.

Many problems which confront human beings require more areas of search. For instance, if the problem were "How can this electric razor be improved?", the human being would try to solve the problem by searching among ideas stored in his memory having some relation. Such ideas might be: make it smaller; place shearing device on its side, make it lighter; increase the number of teeth in the shearing head; make the motor more powerful; change the kind of shearing action; use rotary cutting heads, etc.

Some of these ideas can be combined creating new ideas. For example, increasing the number of teeth in the shearing head could be combined with changing the shearing action; or changing the size or quantity of parts in the razor.

In like manner, a machine may perform these operations: it will search memory areas which are related to the problem for possible concepts which seem to be the desired change, and it will combine or vary them in size and quantity and judge if any of these appear also to be meaningful.

Search for Criteria

In Phase 4, critical reasoning, the machine needs to search for criteria so that quantitive comparisons can be made. In this stage the consequences of the tentative ideas must be weighed. The machine will often be able to do this numerically from the data at hand at this point. Circuits which perform logical, arithmetical, and comparing operations of the kind already incorporated in computers can do this work. However, in the "reflective thinking" computer the programming would be automatic. The machine could determine from the tentative, proposed solution the applicable series of operations capable of reaching a decision about it.

It would appear essential that at least primitive standards of reasoning and criticism be supplied to the machine. In other words, some basis of comparison must have been initially established for it. But with this elementary form of judgment and the natural development within the machine of the process of reflective thinking, other more refined standards of judgment would be evolved by the machine.

In Phase 5, action in regard to the best apparent solution is called for. All the action of the machine up to this point has been internal reflection; yet external action must usually be taken to establish the validity of the solution. Either the machine must act or it must communicate. It must present suggested courses of action and predicted consequences of them. But, and this is most important, the results of such action must be communicated back to the machine. Only then is the process of reflective thinking complete, since information about results is absolutely essential to build up reliable concepts in the machine.

Can Machines Be Designed to Perform Operations of the Thought Process?

Before considering whether machines might be designed to perform the operations of the thought process, let us consider how present machines measure up. We have been able to describe all of the processes involved in the different phases of the process of reflective thought in terms of these basic operations:—questioning, comparisons, combining, rearranging, changing scale or quantity, logic, and arithmetic. All but the first type of operation has been incorporated in present-day computing machinery.

How basic the operation of questioning is to reflective thinking has been emphasized by the previous discussion. It would be valuable then to examine this process more closely. To do so we have chosen a specific question: "What is unfamiliar in this situation?" This question, it will be recalled, is characteristic of Phase 1, situation recognition.

The process starts when data selected by the sensing device is grouped into a standardized set of data which will be called a situation element S. On proper orders which arise out of data itself, a situation element S is stored in memory location M. S is then systematically subtracted from past situations stored in locations r through r + n. (We assume here that S and the contents of location r— abbreviated to C(r)—can be expressed in terms of numbers in a meaningful way.) Then the situation in r through r + n which differs least from S, call it T,[2] can be distinguished by determining which subtraction gives the smallest difference. Knowledge of S and T and their difference is an answer to the question. We have determined both that the new situation differs from what was known, and also what situation it most closely resembles. Thus the area of unfamiliarity has been identified. The information S and T can now be transferred to new storage locations where new questioning routines may operate upon the information to eventually establish the meaning of the unfamiliar element.

The example brings out several interesting points. First, questioning arises automatically from the data. It does not need to be ordered by a tape. This is in contrast to the method of programming prevalent in modern computers. Questioning machines would not require any external orders. Second, questioning does not appear to require any operation that could not be performed by modern computing machines. Hence, we are in a position to answer the question posed at the beginning of the section. Yes, machines can so be designed.

No machines to our knowledge have been designed to perform the operations of Phase 1, situation recognition, and Phase 2, formulation of a problem. Such machines would require several questioning processes. Unquestionably, such machines would not be feasible for some time unless the field of data they would process would be very narrow. They would be the first problem-finding machines built, however.

Game-playing machines have been designed which in a limited sense are capable of the thinking of Phase 3, search for solution. In such machines the problem is well defined by the rules of the game and the machine seeks the best solution. The tic-tac-toe machine and the maze-solving mouse (11) are examples previously referred to. But much could be accomplished by machines capable of questioning operations, self-correction, and having large memory designed specifically to do Phase 3 operations.

Machines, of course, are designed to do operations of Phase 4, critical judgment. However, the addition of questioning circuits would greatly reduce the human programming effort. The machine would learn its programs.

In Phase 5, knowledge of results, only experimental learning machines have been constructed, or rather programed, such as the experiment performed by A. C. Oettinger on the EDSAC (5). Here the machine received a signal indicating approval. Other methods of indicating satisfactory results to machines can be developed; this will greatly improve their ability to learn, and hence, to think.

Anticipating Gains and Losses from Creating Such Machines

Reflective thinking in human beings apparently has grown out of animal drives, chiefly the drives of self-preservation, hunger, and procreation. Somewhere in man's development, the ability to communicate meanings to other men came to pass. This marked a tremendous enhancement of memory to man, since now he could rely upon the collective memory of his culture. The doubts, the unsatisfactory situations, now could be recognized on a wider scale. Problem-solving evolved. Basically, reflective thinking in man has grown up in an emotional being as a tool in adapting himself to an unfriendly world. Animals such as birds, for example, have had no such development and lead purely instinctive and emotional lives.

This leads directly to the answer to the question as to whether machines can have human experience. William James was one of the first to point out how profound the effect the body has upon human experience. Thinking, feeling, consciousness, must all be in terms of our limbs, our eyes, our ears, . . . The mind makes possible a framework of continuing life which many other creatures cannot experience. Machines which have memory can have continuous experience but hardly human experience because they lack the body properties of human beings.

Thus reflective thinking is not the primary purpose of man, but exists only to keep him living. Reflective thinking is a powerful instrument for him to use to pick his way through life, but that is all. On the other hand, the machines we would propose to create for the purpose of reflective thinking would have as their primary aim reflective thought. Reflection would be their business, their main function.

From such devices we should expect a degree of dependability unattained and perhaps unttainable in man. Consider our remarks concerning what brings man's thought process into being. Man may or may not recognize the need for changing a doubtful situation into a settled one. Within its scope, the machine will always recognize this need and from its data will always attempt to find problems which need to be solved.

In man, the underlying emotional character of his being influences his thinking process in many distracting ways. His ability to recall from his memory is greatly influenced by emotional associations. Some ideas, names, or facts, are impossible for him to consciously recall because of some undesirable association. Other ideas are unduly emphasized. When these emotional blocks occur at strategic points in the thinking process, man's thinking will dictate biased action. Of course, emotions lend richness to man's life and variety to the individual's personality, but they do interfere with precision in the reflective thought process.

We can welcome the creation of thinking machines as means of performing thinking in two important ways now hampered in human beings by their emotional heritage; namely, the machines will think more dependably and more precisely.

But in addition, to meet the many problems of the modern world (such as the inexorable pressure of population increase), man is forced to seek every ally and use every instrument. To reduce the labor of mathematical analysis, he has built high-speed digital computing machines. But this leads to drudgery in preparing programs to direct the solution of such problems. Ways must be found to make machines to learn how to program much of their own work, and this is already contemplated. But even this will be found not enough. Machines will have to help man by finding the problems for us in their own special fields and searching for solutions. When such machines are devised, it will probably be just in the nick of time to help man cope with the enormous bulk of problems besetting him.

Summary

Throughout this article, we have standardized our meaning of thinking as reflection in John Dewey's sense. Reflective thinking has been shown to be a series of operations on tentative ideas or suggestions. Machines incorporating memory and a procedure for standardizing meaning, thus forming concepts, are equipped with the raw capacities with which to perform reflective thinking.

The process of reflective thinking proceds from stage to stage by means of a seeking operation called questioning. The five phases of the process require questioning of different character. The phases (situation recognition, problem finding, search for solutions, determining best solution, and test by action) can be resolved into operations. These operations have here been defined only to the extent sufficient to show that they can be performed by electronic or mechanical devices of contemporary design.

Thinking appears to be the endless repetition of a few intrinsically simple spontaneous operations.

Computing machines which have been built have been largely limited by design to the analytical type of thinking involved in Phase 4. Some game-playing machines can do Phase 3 thinking. None have been designed to find problems (Phase 2) or automatically recognize need for new meaning (Phase 1). The number of operations involved in such thinking could be quite large.

An operation basic to reflective thought which has not up till now been given much attention is the questioning process. This process permits spontaneous movement of thought from phase to phase without recourse to external commands.

Only few controls would be available to human operators of such machines. Some interesting controls would be to restrict the kind of data input, or to vary the machine's standards of comparisons.

Machines for reflective thinking will be built to help man solve problems which tend to increase at an accelerating rate as his numbers increase. They will not supplant him, but will be vitally needed tools. They will be superior to man in that their thinking will be more dependable and precise.

As Rudolph Flesch (1) points out, a person believes that a machine can think largely on the basis of his background and emotional makeup. However, if we can accept the validity of John Dewey's conception of the thought process, I believe that we are forced to the conclusion that machines can do reflective thinking. In all probability, it will become vitally necessary for them to do so.

Future Work

Use of John Dewey's concept of thinking leads to promising paths to explore. It would seem to point a way to extend vastly the usefulnes of computing machines. It suggests the building of machines capable of performing the questioning process and the deliberate design of machines, first to do Phase 3 (search for solutions), then Phase 2 (finding problems), and then all phases of reflection. Ways to overcome the limitations of machines for this work need to be found. How can they be best specialized for Phase 1 (situation recognition)? What sort of control of the machine would be best? Should judgment be controlled—or once designed, should it operate freely? Would such a machine become biased? Will construction of such machines add further insight into human thought? Will such machines be errorless? Will they give us insight into what causes errors in humans? Will they develop emotions? **s/p/a**

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9. G. M. Hopper and J. W. Mauchly, "Influence of Program-Techniques on the Design of Computers," Proc. of the I.R.E., Vol. 41, No. 10, Oct. 1953, pp 1250-1254.
10. J. Huxley, "Man Stands Alone," Harper & Brothers, 1941. (The essay on "The Intelligence of Birds")
11. C. E. Shannon "Computers and Automata," Proc. of the I.R.E., Vol. 41, No. 10, Oct. 1953, pp 1234-1241
12. A. Osborn, "Your Creative Power," Scribners, 1950

NOTES

*1 And not only coherence but also consequences.
*2 T is equal to C (r + n).

Guides for the Analyst

Limit your *experimentation.* Don't try to put in everything radical and new. Research must be limited for economical reasons. For the most part use the tried and proven techniques, then develop new and better methods cautiously.

Don't overlook systems details. The last bit of data carried in the system should be analyzed because lack of consideration for details has caused more than one system to fail. Systems is peculiar in this respect. SYSTEMS DETAILS DO *NOT* TAKE CARE OF THEMSELVES.

Don't be partial to one department or group. Your success as a systems man is almost directly dependent upon your fairness to all sides and your careful adherence to advocating that which is good for the entire company. AVOID TAKING SIDES.

Don't give orders to the line workers. Systems work must be done on a staff basis. A staff man only advises. Let the line supervisor give the orders and make all your suggestions directly to him. If an operator asks for your help, contact his supervisor before you give any instructions.

Sound Policies, Procedures

Make

Sound Business Letters

by Richard H. Morris

THERE is little doubt that communication has become one of the hottest subjects in business today. As systems men you are primarily interested in how you fit into this picture and what your department can do to improve the overall quality of your correspondence.

With our first major account, an insurance company, in 1943 I thought that all we had to do was conduct a course in the basic principles of good letter writing—show their staff how to get their letters off to a good, fast start—to write clearly, concisely and to the point—to inject the proper good will and sales appeal—and to close their letters graciously.

And this is still what many so-called letter writing experts are attempting to do today. But my illusions were soon shattered. For unknown to me, they had been collecting carbons of letters written in their home and field offices . . . as well as the form letters and various printed forms which they had developed. These were dumped into our laps, and as we analyzed them, a great light began to dawn. We found that practically everyone in the home and field offices had his own pet set of policies and procedures for handling many different situations—usually at complete variance with others in the same department. As a result, the poor policyholders became totally befuddled, and often gave up in disgust trying to get the specific information they wanted.

We found that before we could even start getting our program under way, it would be necessary to standardize their policies. Otherwise, it would be impossible to teach their people to write clear, accurate letters. This meant getting together with all the vice-presidents and department heads who were involved in these situations, and inducing them to formulate clear-cut, uniform procedures.

Being in this phase of the business you gentlemen no doubt know that it was no easy task. But fortunately, we had plenty of ammunition by showing them the raft of conflicting letters that had been going out of their various offices and departments. They had over 150 forms almost duplicating each other, or completely obsolete. Also 137 affidavits being sent out by the thousands which were utterly useless, and which we eventually eliminated.

But my crowning bit of evidence was two letters from policyholders that arrived at a most appropriate time. The first was from a little old lady, who had written to inquire how much money had been added to her policy through the accumulation of dividends. She received the usual type of form letter, and this was her reply:

> "I received your letter regarding my dividends. I don't understand it at all. In one place you say 'sign.' In another you say 'do not sign.' I am returning all *junk*. Please just let me know how much money I have and oblige."

The other one was from a gentleman who wrote:

> "I have read your letter over and over again, and looking at it from every possible angle, I still think I'm being gypped."

In a large hosiery manufacturing concern, we found they were going to the opposite extreme. In their letters threatening to turn delinquent accounts over to their lawyer, they closed with this little gem:

> "How is your stock of our new fall shades? Wouldn't you like to place an order now so you won't lose any business from our big advertising campaign which starts next month."

Here is another prize that was being sent out by one of the largest hospitalization plans, and was causing irrevocable harm with thousands of their members:

> "We are pleased to inform you that your certificate has been reinstated, and you are eligible for benefits under its terms and conditions. However, if any check sub-

mitted with your reinstatement application is not honored by your bank, your contract shall remain terminated."

When I questioned the department head how often a check was returned for insufficient funds, he readily admitted that it happened very infrequently. Yet, here they were, practically insulting 999 perfectly honest people out of every 1000 that received this tactless letter, all in an effort to protect themselves against a situation that rarely occurred.

Here is another glorious example of where the lack of any clear-cut policy for handling delicate situations resulted in a highly antagonistic letter being sent out from an agency office of one of our largest life insurance companies:

> "Under date of April 3rd we advised you that your remittance sent to us in payment of your $187 premium was 60c short. Unless we receive a balance of remittance by May 3rd, your policy will lapse.
>
> We would appreciate it if you would let us have this 60c. We are attaching a stamped return enevelope for your convenience."

Curt, tactless, ill-advised letters are bound to lose business and customers' good will. Yet, I'm sorry to say, thousands of them are still being mailed out every day. Believe it or not, a short time ago a vice-president of a well-known New York financial concern told me in all seriousness that no one would dare admit that the bank had made a mistake, let alone apologize for it. And hardly a week passes that some salesman for a nationally-known firm doesn't tell me how some snippy, thoughtless letter from the home office has put him behind the 8-ball with some good customer or prospect. You may think these are rare cases. But I'll bet that if your management knew the number of unintentionally curt and inconsiderate letters that go out from your various departments, they would literally "blow their tops."

Why Change?

Of course, I don't know how far you may have to go to standardize, clarify, and humanize your policies and procedures. However, there is a tendency in many companies to feel that because they have been doing things a certain way for years, why bother to change? Frequently the legal departments have formulated many policies with an eye to protecting their companies, completely overlooking what effect they may have on the public. But since your procedures, and how well your employees understand and are able to interpret them have a direct bearing on the letters they write, you may wish to take a second look at your methods with these thoughts in mind.

The second startling discovery we made in analyzing an insurance company's mail was the large number of legal terms they were using to the complete bewilderment of the public. For example—they would tell a policyholder that he "commute his premiums." The poor fellow didn't know whether to go to Jersey City or Hoboken. Or, "You may cash this check without prejudice." John Doe out on a farm in Indiana didn't know whether this meant the check would bounce or not.

This tendency of using unfamiliar technical or trade terminology is not confined to insurance companies by any means. How do you think this lady felt when she received this garbled message from a trust officer in a bank which handled her estate:

> "When you were in about a month ago, we were unable to give you a very large amount and explained this was due to the fact that the allocations had worked against you rather than for you. For in three of the four cases you were obliged to pay out of income into principal certain sums which were shown by the calculations to be an overpayment to income, and only in one case did the allocations show anything due income. The net result of all our allocations was a substantial amount taken out of income and turned over to principal. Have I made myself clear?"

Must Step on Toes

In an effort to clarify and streamline our clients' correspondence, we are often obliged to work with their legal, technical and research departments, as well as with their planning and methods staff. But we found that unless this step was taken at the very beginning, their letters were apt to continue antagonizing good customers and prospects alike. Of course, sometimes you are obliged to step on somebody's toes. Listen to this little find that was written by a regional sales manager of one of the country's largest organizations:

> "We received a telegram from you requesting 116 cases of the above product, however, I knew this was an error and should have been 16 cases. We did not have a sufficient amount in stock to cover this order, therefore, we shipped you 71 cases. I know you cannot use this many and would appreciate your shipping 55 cases back to the (blank) Storage and Warehouse Co.
>
> Please forgive this error, but honestly it was not our fault."

We have invariably found that hundreds of letters are being written every day on recurring situations that do not vary by as much as a dozen words. I'm speaking now of routine collection and credit letters, replies to inquiries, adjustments and complaints, and similar situations that

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MR. MORRIS is a correspondence consultant whose firm did an outstanding job for Mutual of New York in 1943. His base is Westport, Conn.

arise daily in the average office. This costly practice results in the loss of thousands of dollars in unnecessary dictating and typing time, since most of these could be handled just as effectively by guide and form letters.

Of course, this must be done intelligently, particularly in the use of form letters—as most people have become highly critical of them. I feel their chief value lies in the early stages of collecting overdue accounts—if they do not contain too many "fill-ins" which are little more than eyesores. But the use of guide letters is almost unlimited. However, since so few firms have taken advantage of them—or know how they should be prepared or used—let me explain them.

Guides are in no sense form letters. Rather they are guides or patterns for your staff to follow in writing letters that are clear, concise and gracious, bearing real good will and sales appeal. In many cases the dictators need only designate the key numbers of the guides, and give their secretaries or typists the necessary information to be filled in before they are retyped as complete personal letters.

Use Automatic Typewriter

If your volume of mail warrants it, guides can be set up on automatic typewriters and even more time saved, since one girl can turn out 300 to 400 letters a day on several machines, as against the usual 50 to 60 when individually typed. Through the development of such guide letters, an insurance company estimates they are saving approximately $85,000 annually. The use of guides in the consumer service department of a food corporation which handles thousands of inquiries and complaints every month from millions of housewives has not only speeded up the handling of their daily mail, but has reduced dictation by about 60%. In just one section of a well-known publisher, our guides have cut their dictating staff from 8 to 5 people at a savings of $1,200 a month.

These initial steps are absolutely essential to the success of any program designed to improve communications with the public and cut down on office overhead. They should come under your province, whether you are directly or indirectly responsible for any correspondence improvement program you may conduct. You should see to it that they are made a definite part of such a program. And there are three other common pitfalls you should strive to avoid. They are:

First: For years the idea has persisted that most anyone who could speak good English and knew something about the business could write effective letters. If this is true, then why are so many stuffy, involved, downright harmful letters going out over officers' and department heads' signatures?

It is because of this mistaken idea that many firms in an attempt to improve their correspondence are simply giving their employees a course in grammar, construction, punctuation and spelling. Or have had manuals prepared that are little more than a secretary's handbook that could be purchased in any book store.

If you want your staff to write better letters, you must go far deeper than this purely academic approach. You will have to start by changing their attitudes. Make them realize that letter writing is not a boring, routine chore, but a golden opportunity to build good will and expand the company's business. You will also have to teach them to think clearly, use good judgment and tact in handling many different situations.

Second: The second point I would like to stress is that you cannot bring about any lasting improvement in the quality of your letters through any quick "shot-in-the-arm" method. Many concerns that have attempted to do this through pep talks, lectures, holding occasional clinic meetings, or reviewing carbons at infrequent intervals found the results disappointing, and a great deal of time and money wasted. It must be a continuing process of correcting individual weaknesses, and keeping a staff from slipping back into old faulty habits.

Third: Executives who are keenly aware of every new development and possible improvement in their field, and keep a close watch on their expenditures are usually completely unaware of the money-making and money-losing possibilities of their daily correspondence. It is a rare occasion when management knows with any degree of certainty:

1. How much a letter actually costs, and how much is being spent annually on their correspondence.
2. Whether or not it is being handled economically.
3. If their letters are building good will . . . or actually detracting from their company's advertising and public relations programs, or the efforts of their men in the field.
4. And how to train their staff to write more effective letters.

The average letter costs $1.50 and up, depending on the salary of the person who writes it. But take this minimum figure. If you are mailing out 100 letters a day, that means you are spending about $26,000 a year on your correspondence. If you send out 500 daily, it is costing you around $130,000 a year. A thousand letters come to $260,000 and 2,500 to $650,000. If you wonder why these figures run so high, may I point out what our 12 years' experience has disclosed:

1. The average letter is from 20% to 50% longer than necessary.
2. From 12% to 15% of all letters written in the average office are so-called "follow-ups" to explain what the writer mean to say in the first place, or to induce a reply. In other words, they would have been unnecessary if the first letters had been clear and explicit, and

(*Continued on Page 30*)

Fitting Systems and Procedures into the Business Enterprise

by M. S. Shane

IN OUR company, we have been giving considerable thought and study to the development of a policy manual which would best meet our needs. We determined that our first step must be the precise definition of related terms and concepts, such as objective, policy, and practice, that are used in describing the activities of a business enterprise. The literature that we reviewed has proved that there is no unanimity of thought on this subject.

In trying to clarify our own thinking on what we were actually talking about, *The Wheel of Enterprise* was evolved. Heretofore, certain texts that we reviewed indicated that the normal order of business enterprise is a straight line. However, it was suggested to us, and we agreed, that it must be a circle.

Before we can use such terms as management, objectives, policy, and practices, we should first establish a common understanding as to what we mean by them. These terms are expected to have a common meaning to businessmen. No doubt the assumption should be true but, as I pointed out previously, it is open to question. Actually, most of the experts are not in agreement among themselves and use such terms interchangeably.

The definitions which we have here are the by-products of definitions accumulated from various sources which we have refined and put into practical, useful terminology. For clarity, these concepts are shown in diagramatic form. We expect that each company will write their own definitions and try to be reasonable about standardization. You do not need to agree with these definitions; the important point is that you develop and use your own.

Exhibit I—Four Spoke Wheel of Business Enterprise

Management is the administration of a business enterprise through executive leadership which establishes the objectives of the enterprise, then plans, organizes, and controls its human and material resources to fulfill the objectives. The objective is placed at the very top of the chart. A clear statement of the objective is a prerequisite to the starting of a business enterprise or with the carry-

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MR. SHANE is manager of the Costs and Methods Department, Cleveland Electric Illuminating Co.

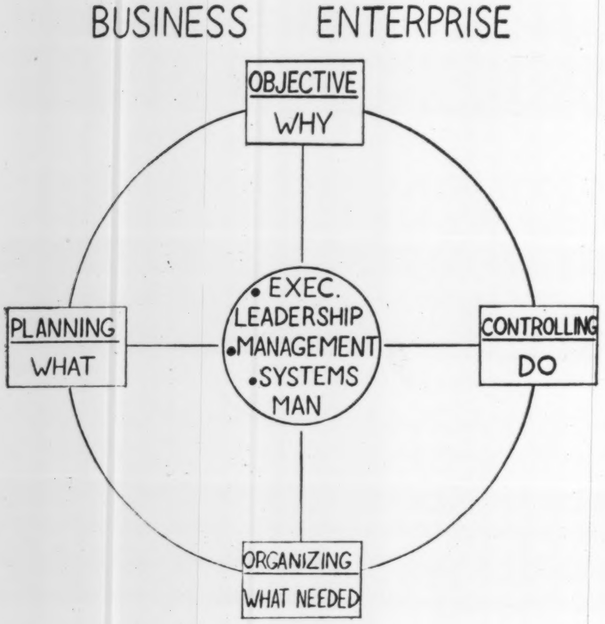
BUSINESS ENTERPRISE
OBJECTIVE
WHY
PLANNING
WHAT
• EXEC. LEADERSHIP
• MANAGEMENT
• SYSTEMS MAN
CONTROLLING
DO
ORGANIZING
WHAT NEEDED

Exhibit I

ing on of *any activity by the concern as a whole* or by *any element of it*. By definition, *an objective* is a value that the business organization is expected to acquire, create, preserve, or distribute. An objective answers the question *why* it should be done. It is any legitimate satisfaction of the needs and desires of customers, the business, or its members.

After the objective has been set, management then *plans* by means of executive leadership. A definition of planning would include the formulating of the policies of the organization, the defining of the enterprise's practices, and the determining of the procedures necessary to achieve the objectives set by management. The planning phase of management answers the questions, "what, who, where, when, and how to do."

Next, management *organizes* by means of executive leadership. Organizing is the combining of the necessary facilities to implement the work to be done. Facilities answer the question, "What is needed to do the work?"

After the objectives have been set, plans have been laid, and facilities have been organized, management then seeks to control. Controlling consists of coordinating the system, directing the work activity, and appraising the performance. In appraising the performance, management determines whether the objective has been fulfilled. In this way, a circle is completed from the time the objective was set to the time that the work was appraised.

Exhibit II—Eight-Spoke Wheel of Enterprise

As you can see by this exhibit, business enterprise moves in the form of a wheel. The wheel would revolve, in sequence of operation, clockwise. Placed in the center of the wheel, management is represented by executive leadership. Executive leadership is the propelling and dynamic force which sets into motion the wheel of enterprise. I have previously defined objectives, planning, organizing, and controlling for you, and now would like to tie in these concepts with the wheel of enterprise. Starting at the top of the wheel, objectives must be set by executive leadership first.

Next, executive leadership must plan their operation by formulating policies, defining practices, and determining or devising procedures.

After management, by executive leadership, has planned their operations, it is necessary to organize these operations by assembling the available facilities.

Once the facilities are organized, management then goes into the stage of controlling its operations. There are three phases to control: first, there is the pre-action control (coordinating the systems involved in the operation); second, there is during-action control (directing or supervising the actual work); and third, there is after-action analysis or control. After-action analysis involves the appraising of the performance. This represents the follow-up stage of the entire wheel of enterprise sequence.

We have now had an opportunity to examine the relationship of the eight concepts or spokes that make up the wheel of enterprise. Now, let us tie in these eight concepts to the corresponding functions of management.

Functions and Concepts of Management

Objectives are the values that the business organization is required to create and maintain. Such values can only be created by work. A value, for example, would be the making of a product. There is economic value to this product when it can be exchanged and used by others. The

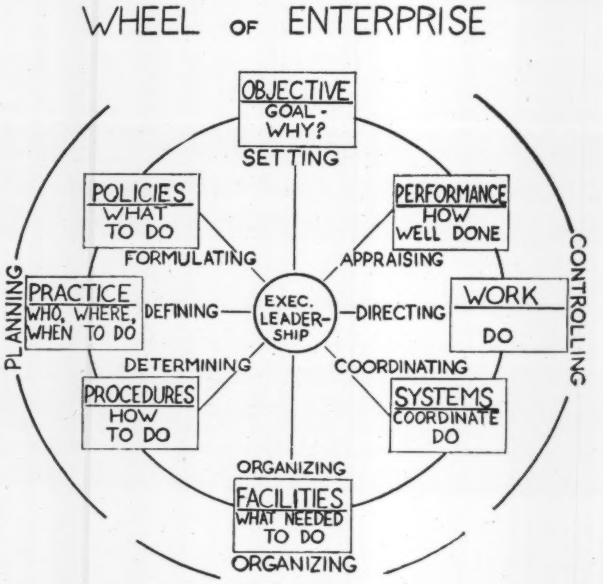
WHEEL OF ENTERPRISE
OBJECTIVE
GOAL -
WHY?
SETTING
POLICIES
WHAT
TO DO
FORMULATING
PERFORMANCE
HOW
WELL DONE
APPRAISING
PLANNING
PRACTICE
WHO, WHERE, WHEN TO DO
DEFINING
EXEC. LEADERSHIP
DIRECTING
WORK
DO
CONTROLLING
DETERMINING
COORDINATING
PROCEDURES
HOW
TO DO
SYSTEMS
COORDINATE
DO
ORGANIZING
FACILITIES
WHAT NEEDED
TO DO
ORGANIZING

Exhibit II

objective, therefore, tells us why it should be done. It is the purpose, the aim, or the destination that we have in mind.

Let us look at the definition of policy. Policies are general statements, either expressed or implied, of those principles and rules that are set up as guides and constraints for the organization's thought and action. They tell us *what* should be done. Policies are principles that relate work (cause) to value (effect) in some manner that is meaningful.

After we have set our objectives and formulated our policies, we must define the practices or methods which can be used to accomplish the job. Practices are more specific yet broad statements describing the manner in which time, place, and people are used to accomplish the job. However, reasonable exercise of judgment is still necessary. Questions as to *when* and *where* it should be done and *who* should do it are answered. Standards and specifications are set.

It is now necessary to determine or devise the procedures. Procedures are formalized statements or specific instructions that govern the operations comprising a system so that no further judgment is required. Thus, a procedure tells us *how* to do the job and it implies that this is the best method known at this time.

Organizing the *facilities* is the next step that we must take. Facilities can be defined as the men, material, equipment, machines, tools, and other factors necessary to implement the job. In other words, facilities tell us *what* is needed to do the work.

Our next spoke in the wheel of enterprise would be *systems*, which, as we see it, is the over-all mechanism setting into motion the whole job or any major activity. It provides the dynamic power to otherwise static facilities. Systems may, therefore, be defined as the coordinating of activities with respect to time and order of accomplishment to satisfy the requirements for the completion of a project. Systems provides us with pre-action control. Without this pre-action control, it would be impossible for us to determine how we are doing in relation to our objective.

Must Direct the Work

After we have coordinated systems, it is necessary to direct the work. Work can be defined as the energy and effort expended towards achievement of the objective. It is the doing or action creating the utility or value which satisfies the objective. In other words, work creates the value.

Performance is the last spoke in our Wheel of Enterprise. Management appraises performance by after-action analysis. Performance, by definition, is a measure of the quality, quantity, or time of accomplishment in cost of the work done. It answers the question as to how well we did. It would be impossible for us to determine how well we did if systems people do not establish in the very network of every system the means for this after-action analysis. After-action control measures and evaluates work done in order to ascertain whether the objectives are adequately fulfilled.

Each concept of management has a corresponding function. These functions are the "do" phase of executive management. They are: (1) *Setting* objectives, (2) *Formulating* policies, (3) *Defining* practices, (4) *Determining* procedures, (5) *Organizing* facilities, (6) *Coordinating* systems, (7) *Directing* work and (8) *Appraising* performance.

Each spoke of this wheel is dependent upon the other. To remove one of the spokes would be equivalent to the preventing of the circulation of the life-giving blood needed by an enterprise.

This circular concept of a business enterprise is not only applicable on a company-wide basis, it can be applied to every level of management and to every element of the organization, including systems. Each element must have its objectives, its policies, its practices and procedures, and it must be able to appraise its final result and re-evaluate its policies.

Fitting a Systems Department into a Business Enterprise

All modern enterprises, whether for profit or not, possess three primary, common classifications of management problems:

1. Determination of the objectives of the enterprise, the basic policy as to its goals, and what will be its scope of operations.
2. Determination of the best methods for organization and systematic operation and the persons and groups which will perform the functions which are required to accomplish the objectives of the enterprise.
3. Administration of persons in groups as a team of cooperating individuals to most effectively accomplish the objectives of the enterprise using the previously determined operating patterns.

A systems department should concern itself with the second of these problems: The methods of translating management policy into action and of finding the most effective, simplest, and cheapest means for accomplishing every task. This systems problem is universal. It is present in every undertaking, large or small. How effectively this problem is met will frequently decide the success or failure of the undertaking.

A systems department's primary area of concentration consists of the study, analysis, and improvement of the systems which service, control, and coordinate all the operations of the enterprise. Systems analysis thus encompasses the design of planning tools for giving direction to the enterprise's activities. That, as shown on our chart, would include assisting in formulating the policies which will act as guides and constraints for the organization's thought and action, defining of practices which describe the various methods which could be used to accomplish the job, and the determining of the procedures which govern the operations comprising a system.

Systems analysis would include aiding in the organizing of the men, materials, machines, tools, and any and all other factors necessary to implement the job. Systems analysis also includes, and this is of primary importance, the design of control tools to insure that the objectives have been met. Going to our Wheel of Enterprise, this particular phase would include coordinating the systems, setting into motion the whole job or any major activity, and evaluating the performance.

Exhibit III—Systems Man Coordinates Activities

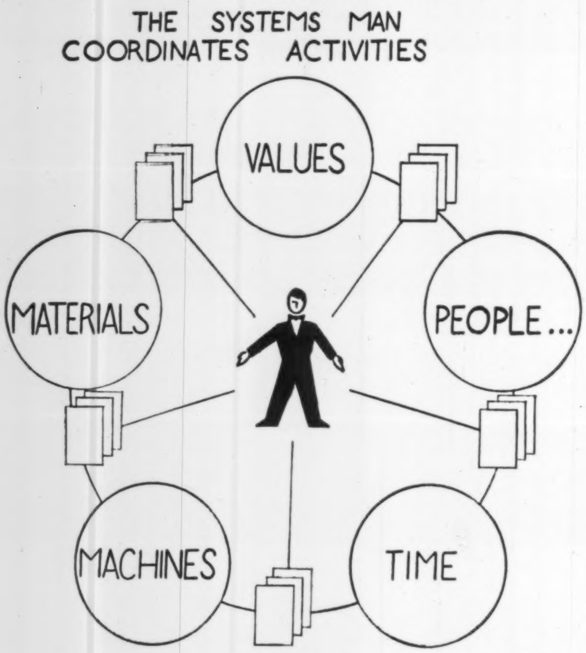
THE SYSTEMS MAN
COORDINATES ACTIVITIES
VALUES
MATERIALS
PEOPLE...
MACHINES
TIME

Exhibit III

Application of the systems man's services will benefit the business enterprise in numerous ways. By coordinating all activities of the enterprise within a workable organization structure, he will enable the business to produce and deliver its products and services on schedule as required by the customer and at the lowest possible costs. Specifically, some of the benefits which I would expect to be derived from a systems department are:

(1) Reduction in the operating time cycles.
(2) Lowering of inventories.
(3) Reductions of errors in predicting cost and delivery dates.
(4) Elimination of unnecessary functions and activities.
(5) Faster working capital turnover and reduction of working capital requirements.
(6) Greater operating flexibility—speedier transfer of top management decisions into action.
(7) Elimination of the conflicting systems and operations which work at cross purposes.
(8) Increase in the effectiveness of supervision.
(9) Strengthening of the organization structure of the enterprise through the disclosure and elimination of practices which violate sound organizational principles.
(10) Reduction of the clerical cost of performing the planning, organizing, controlling, and service functions required in the enterprise.

Exhibit IV—Systems Department in Center of Eight-Spoke Wheel

The concepts and functions which we have discussed pertaining to the Wheel of Enterprise are applicable to the company as a whole, every management and element level, and to individuals. Every systems man should know and understand these principles and relationships in order to be able to evaluate the organization within which he is working. Let us put the systems man in the center of the wheel and see how its principles affect him.

A systems man's objective, and there is only one, is to provide an improving service to reduce cost. It doesn't matter whether we call his objective to effect economies, to correlate functions, or to promote mechanization; no matter what it is called, it will fall into this category. That is the reason for his existence. That is his objective. That is why he is in business.

Now that we have developed an operating objective, we might formulate the following operating policy to guide him towards obtaining his objective: The operation of an effective business organization requires efficient sys-

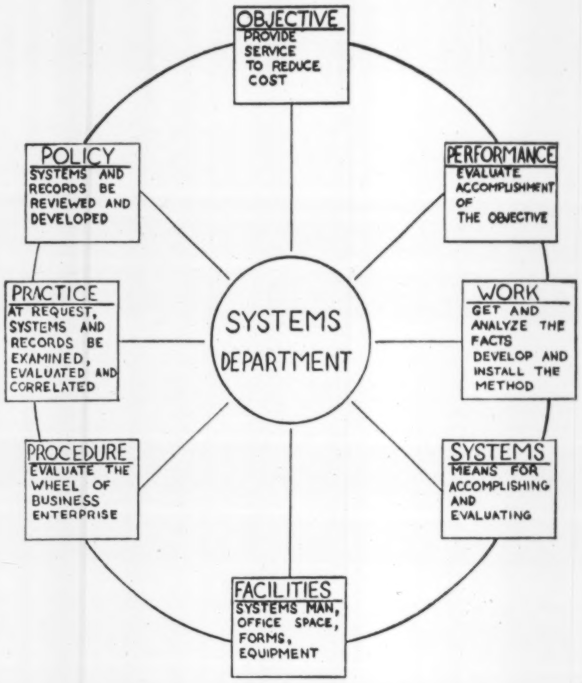
OBJECTIVE
PROVIDE SERVICE TO REDUCE COST
POLICY
SYSTEMS AND RECORDS BE REVIEWED AND DEVELOPED
PERFORMANCE
EVALUATE ACCOMPLISHMENT OF THE OBJECTIVE
PRACTICE
AT REQUEST, SYSTEMS AND RECORDS BE EXAMINED, EVALUATED AND CORRELATED
SYSTEMS DEPARTMENT
WORK
GET AND ANALYZE THE FACTS DEVELOP AND INSTALL THE METHOD
PROCEDURE
EVALUATE THE WHEEL OF BUSINESS ENTERPRISE
SYSTEMS
MEANS FOR ACCOMPLISHING AND EVALUATING
FACILITIES
SYSTEMS MAN, OFFICE SPACE, FORMS, EQUIPMENT

Exhibit IV

tems and records. Therefore, systems and records used in the performance of company work will be reviewed or developed.

After the policies have been formulated, the second step in the planning phase is to define the basic practices. Following through with our example, we would establish the practice that, "At request, systems and records would be examined, evaluated, and correlated."

After the various systems practices have been defined, it would be necessary to determine the procedures required to put these practices into effect. To determine the procedure, it would be necessary for the systems man to evaluate the complete wheel of business enterprise. The systems man must look at the policies, practices, procedures, facilities, systems, work, and the performance before it would be possible to determine the procedures necessary.

Following completion of this planning stage, the systems man would begin to organize the facilities needed, such as, obtaining the necessary men, office space, forms, and equipment. In our example, these facilities are the analysts, desks, space, equipment and forms.

Now, the systems man must build into his own system the means for accomplishing and evaluating. Here is where the systems man provides the dynamics to move the otherwise static work into live action. The systems man then proceeds to the actual work, which is to gather and analyze the facts, to develop and install the new method procedure or system.

If the systems man has done his job correctly, he has built into the system the necessary means for evaluating how near he came to the accomplishment of the objective. This is shown as the last block in our chart. This brings us back to the evaluation of the basic policies, practices, procedures, facilities, and systems that have been used to accomplish the objective.

Exhibit V—The Wheel as Applied to a Sample Procedure

We have used the wheel of enterprise to establish definitions and relationships. It has been used to explain the business enterprise functions. It has also been used to show how systems fit into an over-all business enterprise. Now, let us see how you can apply it to even the simplest of procedures.

The problem is to schedule typing material so that all typing deadlines can be met. Our objective then is to provide good typing service. The systems man must formulate a policy telling what to do; for example, he would say all typing for this section will be centrally controlled. After formulating policies, he must define the necessary practices which will answer who is going to do the work, where the work is to be done, and when it is to be done. As an example, he would have the systems supervisor receive and schedule all typing work.

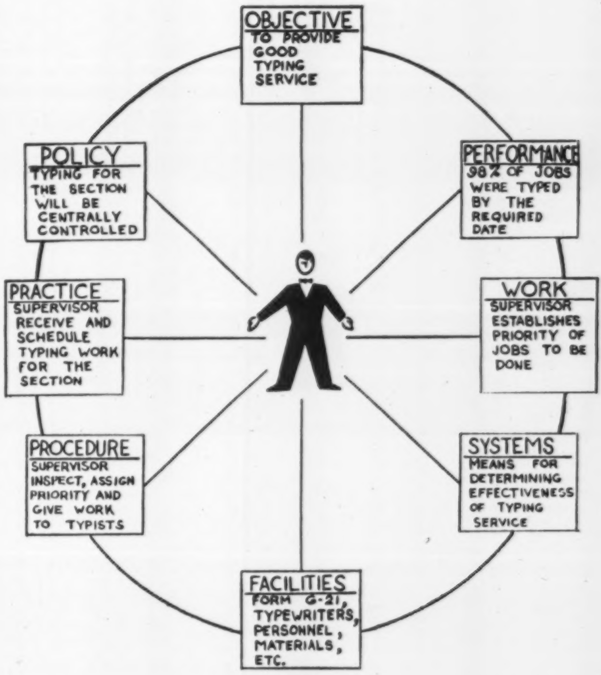
OBJECTIVE
TO PROVIDE GOOD TYPING SERVICE
POLICY
TYPING FOR THE SECTION WILL BE CENTRALLY CONTROLLED
PERFORMANCE
98% OF JOBS WERE TYPED BY THE REQUIRED DATE
PRACTICE
SUPERVISOR RECEIVE AND SCHEDULE TYPING WORK FOR THE SECTION
WORK
SUPERVISOR ESTABLISHES PRIORITY OF JOBS TO BE DONE
PROCEDURE
SUPERVISOR INSPECT, ASSIGN PRIORITY AND GIVE WORK TO TYPISTS
SYSTEMS
MEANS FOR DETERMINING EFFECTIVENESS OF TYPING SERVICE
FACILITIES
FORM G-21, TYPEWRITERS, PERSONNEL, MATERIALS, ETC.

Exhibit V

The next step is to determine the necessary procedures which will answer how to do the job. In the example we have been following, the supervisor inspects, assigns priority, and gives work to the typist. After completing the planning stage of the job, it is necessary to organize the facilities that are needed to do the work. These would be the form used for gathering the necessary data, typewriters, personnel, and material.

The systems man then has to coordinate the system and build into it the means for determining the effectiveness of the typing service. The work is done acording to the procedure permitting the supervisor to establish the priority of jobs to be done. After the work has been done, and because the systems man has built into the system the means for determining the effectiveness of the typing service, the performance is appraised. In this example, 98 per cent of the jobs were typed by the required date. Looking back to our objective, it is evident that it has been met.

In any business enterprise today, it is necessary to provide a basis for uniform thinking throughout the organization and within each element of that organization. One way to insure this unity is to provide personnel with standard definitions and concepts to which they can refer regularly in their work. Once these definitions have been established, it is possible to develop practical applications for the over-all organization as well as for each element in the organization. This practical application by the business organization to the definitions and concepts is the reason for the development of this wheel of enterprise.

The illustrations on the wheel prove conclusively that systems people can be very instrumental in developing and proposing practices and a policy manual that would include:

1. Basic policies which establish the long range objectives of the company.
2. General policies which govern the relatively short range objectives of the company.
3. Departmental policies.

In conclusion, *Only* by *Thinking* and *Working* in *Circles* can systems people analyze the objectives, properly plan, control and organize, and ultimately arrive at a solution to a problem that will contribute greatly to the successful direction of a business. s/p/a

AUTHOR'S ACKNOWLEDGEMENT — Valuable comments during the development of this material were received from Ralph C. Davis, Professor of Business Organization at The Ohio State University. Certain of these concepts were also taken from Mr. Davis' book, *The Fundamentals of Top Management*, Harper and Brothers, 1951.

Worth Reading—

selected articles from the management press

"Photocopy Your Volume Inquiries"—Mario Di Pietro, *Management Methods,* March 1954.

A magazine receives 5,000 reply cards a month with an average of 5 different coded inquiries, each of which must be forwarded to advertisers. Cards are first sorted by lowest code number. Cards marked #1 are placed one overlapping the other on masking tape with basic information shown, and photocopied. One print contains 14 cards. Two prints can be made every 30 seconds. Copied cards are then resorted by next higher number shown and processed.

"Judging Your Purchasing Efficiency"—Alfred W. Sutter, *Management Methods,* April 1954.

A check list of 20 questions covers 8 basic aspects of purchasing: (1) Specifications, (2) Buying, (3) Follow-up, (4) Invoice checking, (5) record keeping, (6) Salvaging, (7) Receiving and storing and (8) Research. An evaluation chart is shown on which percentage efficiency can be marked for 30 items relevant to purchasing. A comparison of effectiveness can be made by entering on a second chart data on the number and cost of employees, total purchasing activity and other related items.

"Know Your Office Costs"—J. McCall Hughes, *The Controller,* January 1954.

Cost data are used to evaluate changes in systems and for control. However, top management must desire and use such data otherwise it is a waste of time and money. One insurance company maintains four types of data: Costs by organization unit and type of experience, by budget, and by function (e. g. payroll). The major steps required in costing of functions are presented to illustrate the point that compilation of cost data need not be expensive.

"U. S. Steel Sets Up Automatic Office"—*Office Management,* March & April 1954.

Detailed presentation of U. S. Steel Corporation system which utilizes a five channel punched tape to record data at point of origin and then uses data mechanically for all subsequent operations. Common office machines are actuated by the tape and simultaneously execute a task and prepare a tape for other machines. Self-perpetuation of data is the objective.

"Open Your Eyes To Theft"—George A. Conner, *Office Executive,* April 1954.

To prevent theft, a good system of internal controls vigilantly implemented is necessary. Five aspects of most control systems are discussed in detail and suggestions made for each: (1) Analyze work assignments, (2) Control cash receipts, (3) Control cash disbursements, (4) Control merchandise movement, (5) Personnel aspects.

"Network Dictation System Links Plant Offices a Mile Apart"—*Management Methods,* April 1954.

A manufacturing company has installed a system using 4 recording machines taking dictation from 38 stations. Telephone handsets are used and these can be plugged in to special outlets wherever desired. Thus, the 38 handsets are used by 73 persons. Play backs are possible and partially completed discs may be removed for transcribing and later replaced.

"One Writing Order and Invoice System Saves $2,000 Annually"—Landon B. Atkins, *Management Methods,* April 1954.

As orders are received, a duplicating master is prepared from which all necessary copies for order-handling are duplicated. In addition, bills of lading are run with prices masked out. Invoice copies are later obtained and pre-numbering of masters insures billing control. The elimination of typing formerly required for 120,000 invoices a year results in a net saving of $2,000 yearly.

"Purchase Order Follow-up Controls Vendor Deliveries"—*Management Methods,* April 1954.

Three copies are used in this follow-up. Vendors merely insert promised shipping date on a self-addressed reply card. This information is then placed on two copies held in suspense: One is forwarded to the requisitioning department, the other is used to adjust committed funds.

"Stock on Wheels Pays Off, Saves Space and Time"—T. H. MacCauley, *Management Methods,* April 1954.

Improved utilization of floor space by 65% was the experience of one company with tiers of storage bins which slide from right to left on tracks. Three rows of bins, one behind the other, are used. Each rack or bin slides to permit access to those behind.

"Automation: No Easy Answer"—Edward Waygren, *Office Management,* March & April 1954.

A sober second look at various aspects of computers: economics, input-output bottlenecks and personnel problems. Due to large equipment costs, an office force of 100 people is not likely to benefit. Although computers are strong on calculation and weak on input-output, clerical procedures usually require the opposite. Highly trained technicians will be required in place of clerical personnel and a problem of monotony will have to be faced. Suggests an evaluation of computers only after a procedural housecleaning to see if the additional benefit is worth the cost. Recommends the development of simpler, slower machines tailored for clerical operations.

"System—Master or Servant"—Samuel L. H. Burke, *Systems,* January 1954.

The contribution of well designed systems to profitable operation of business enterprise is that it releases administrators from routine considerations and allows attention to be focused on exceptional matters and significant problems involving policy. The basic steps in formulating a system are the gathering and analysis of data, selecting the best possible alternative plan, instructing participants in its use, establishing controls, and providing for incentives.

Memorandum—

To: **SPA Members**

From: **A. B. Matey,**
Western Electric Co.,
New York, N. Y.

Subject: The IBM Model III Tape Processing Machine

THIS MACHINE resembles IBM'S 701 in appearance but where the 701 was primarily a calculator and constructed to handle numeric information, the 702 is a data processing machine that can handle alpha as well as numeric characters with equal facility.

The heart of this machine is called the Arithmetical and Logical Unit (ALU) which contains as its main constituent 10 Cathode Ray tubes which provide 10,000 digits of electrostatic storage; the accessibility in and out of this storage is calculated in microseconds. All calculations and directions to actuate the auxiliary equipment are directed by this unit. All information on the tubes disappears when power is turned off.

Another means of storage is the magnetic drum which incidentally is optional equipment (as are several other parts of the auxiliary equipment). Each drum contains 300 addressable sections of 200 characters, giving a total storage of 60,000 digits. A maximum of 30 such drums can be connected to the main frame and all controlled by the ALU. The accessibility of this information is not as fast as the cathode ray tube, but it is fast enough to be measured in milliseconds. Information contained on the drum must be removed a line at a time (maximum 200 characters) and stored in the ALU memory unit where it is then possible to select that part of the line that is required. Information on the drum remains constant and can only be changed by reading in other information over the same field.

The third element of storage is magnetized plastic tape. All information to be imprinted on the tape must come originally from punch cards. Once on tape the information can be used indefinitely or can be erased and the tape used over again. Information is imprinted 200 characters per inch. The tape moves 75 inches per second which is the equivalent of reading approximately 4,000 punch cards per minute. The maximum length of tape is 2,400 feet per reel which is capable of storing information equivalent to that contained on 25,000 punched cards allowing for ¾″ gap between 80 column records.

Auxiliary Equipment

The following auxiliary equipment used with this machine is quite flexible and can be used in tandem or separated and used as individual units, and in most instances a maximum of 100 units of each can be hooked to one unit of ALU and all controlled and operated from this central source.

Card Reader—Reads cards at a constant speed of 250 cards per minute and can channel information directly to the cathode ray tube for storage, to the magnetic drum or to a tape machine. If necessary, this card reader can be detached from a main unit and hooked up directly with the tape unit, which appears to be the most practical use where large volume of detail cards are involved, especially for repetitive operations.

Card Punch—Punches summary or reproduced cards at rate of 100 cards per minute. It is not conceivable that such a machine will be popularly used.

Printer—This machine contains the printing mechanism of the 407 Tabulator having a full 120 counters of alpha or numeric characters listing at 150 lines per minute. This machine can be actuated by direct impulse from the ALU or it can be detached from the main unit and operated by punch card or tape.

Electric Typewriter—This machine can be operated through the ALU unit only. It operates at a speed of 600 characters a minute (120 5-character words per minute).

An entirely new mechanism is being used as a built-in feature of all auxiliary equipment (except the typewriter) which is known as buffer storage. This type of storage will hold one line of information in reserve so that the ALU will not be stopped because of delays in printing, punching, or writing on tape, the stored line will feed out when the mechanism it controls is free to accept the information. This action will occur regardless of whether the equipment is used as part of the ALU or operated independently.

There are many controls built in the machine for checking accuracy. Some are an automatic part of the machine that can be established, merely by flipping the proper switches on the console, or operator's maintenance panel, others must be built into the program, as needed.

The programming of this machine is not too difficult; however, it is absolutely essential to know and define the job to be performed in minute detail. The instructions to the machine must be explicit and accurate since all program information is internally stored, no control panels are used in any parts of the complement of equipment.

The IBM have a tape sorter-collator in laboratory stages of development. This machine will make it possible to add information at random in master tape reels, or to create new reels where only part of the information contained on the master reel is needed. It will, in effect, permit the same type of sorting, merging and collating with tapes as is now possible with cards. The machine will not be part of the ALU but will be constructed to operate with the unit if some particular application required this feature.

There is still a need for a faster method of input other than punch cards at the rate of 250 cards per minute and, of course, in output, where the printer can do no better than the present tabulator which imprints 150 lines per minute. However, with expansion of storage capacity, rapid calculation and fast tape reading now available, it is conceivable that all efforts will be made to speed up both these laggards. **s/p/a**

Sound Letters

(Continued from Page 22)

appealed to the reader's self-interest strongly enough to get him to take the desired action.

3. From 30% to 90% of the letters being dictated in various departments could be handled at a great savings in dictating and typing time through the appropriate use of form and guide letters.

In closing, let me remind you of several important timely points. Maybe it didn't matter much over the past 12 years whether your letters were good, bad or indifferent, how much they cost you and whether they built company good will and prestige or not. But competition is already becoming increasingly keen. Customers are more "service conscious." Collections are slowing down . . . and office overheads are soaring to new heights. How are you going to meet this growing trend? Of course, good letters are not the entire answer. But since 85% of business today is conducted either wholly or partially by mail, is there any other medium you can use which can do so much and cost so little?

If properly organized and handled, your correspondence can help you maintain friendly customer relations and thus protect you against the inroads of competition. Furthermore, it can turn more inquiries into orders, speed up collections, back up your advertising and promotion as well as your men in the field. **s/p/a**

BOOK REVIEW

Cost Reduction in Wire Communications

by Roy Stone, 1953

The Christopher Publishing House,

Boston 20, Mass., 342 pp. Illus. $10.00

Reviewed by Richard Neumaier, Systems Consultant,

Philadelphia, Member of Keystone Chapter

In no field has electronics played a larger part than in communications. To keep up with such a complex branch of engineering is not possible for the layman whose main, and sometimes only, contact in communications is the telephone. A book such as this is therefore a valuable tool and source of information for systems people requiring knowledge about the complex set-up of wire communications systems.

Generally the selection of the system to be used has been left to the telephone company, but a good systems man should be able to understand the telephone requirements of his own organization and know available equipment and its application so as not to depend entirely on the recommendations of an outside organization. Obviously, if we have a better understanding of what telephone equipment can do for us, we can use it to better advantage and, as the title of this book suggests, at less cost.

Mr. Stone has done a complete job in explaining the facilities available to the small, medium sized and large business houses. There are case histories of small organizations and their expansion into larger ones with increased wire communication requirements. Several chapters are devoted to case histories, and from illustrations of the most practical and economic use of the various types of facilities the reader can draw parallel conclusions. Actual rates and charges are part of the text and the calculation of costs is clearly outlined. These calculations indicate where savings can be accomplished and should help to evaluate the cost of a contemplated system.

Chapters cover the telephone service required by small, medium and big businesses, toll and long distances expenses, operator training, privately owned systems, teletypewriter exchange service, leased wires, and such service as self-answering telephones, mobile telephone service, and telephone answering service. The description of equipment and systems is in simple language and the case histories are very clear and understandable.

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